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Hawaiian Electric

IGP Stakeholder Council Meeting Resilience

November 9, 2021

Agenda

- Reliability Meeting Recap
- Pulse Check
- Introduction and Context
- Roles of Preventive and Mitigation Solutions
- Identification of no-Regrets Activities to Start Sooner than Later
- Efforts to Improve Forward-Looking Resilience Planning and Options Analysis

Recap Reliability Meeting

Objectives

- Basic objective: Steady, adequate, and generally affordable energy to customers, most of the time
- Generation resource diversity
- Plan reliability for extreme events
- Evaluate cost of higher levels of reliability

Capabilities and Strategies to Support Objectives

- Reliability for Tier 1 customers should be a priority
- Evaluation of reliability contributions of different generation technologies
- Define and clarify terminology –firm generation, non-firm generation, hybrid solutions
  - Firm generation could be affected by forced outages, fuel supply
- The role of microgrids
- Customer solutions for reliability (DER)
- T&D hardening
- Investigate future technologies like green hydrogen
- Consult community on reliability priorities

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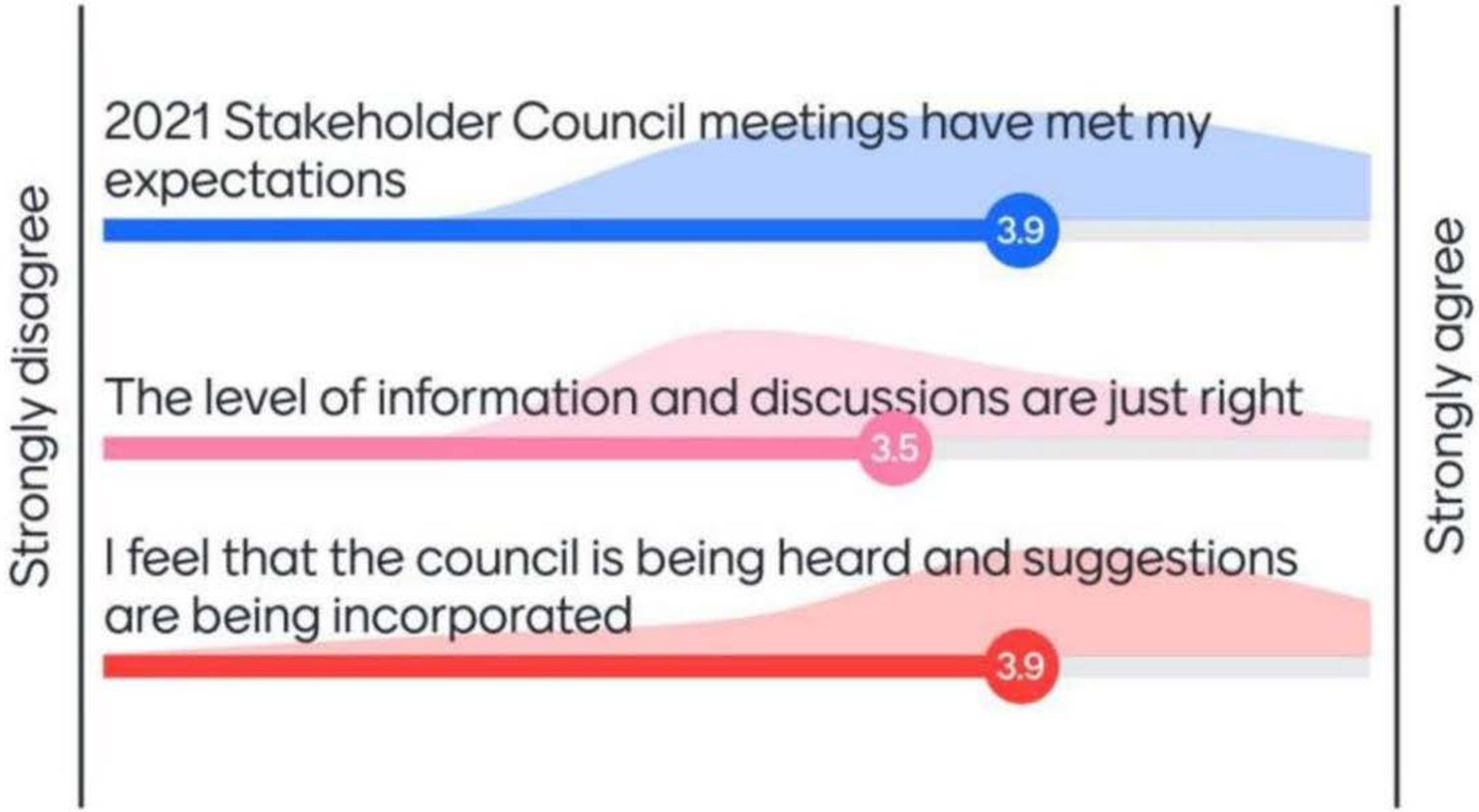
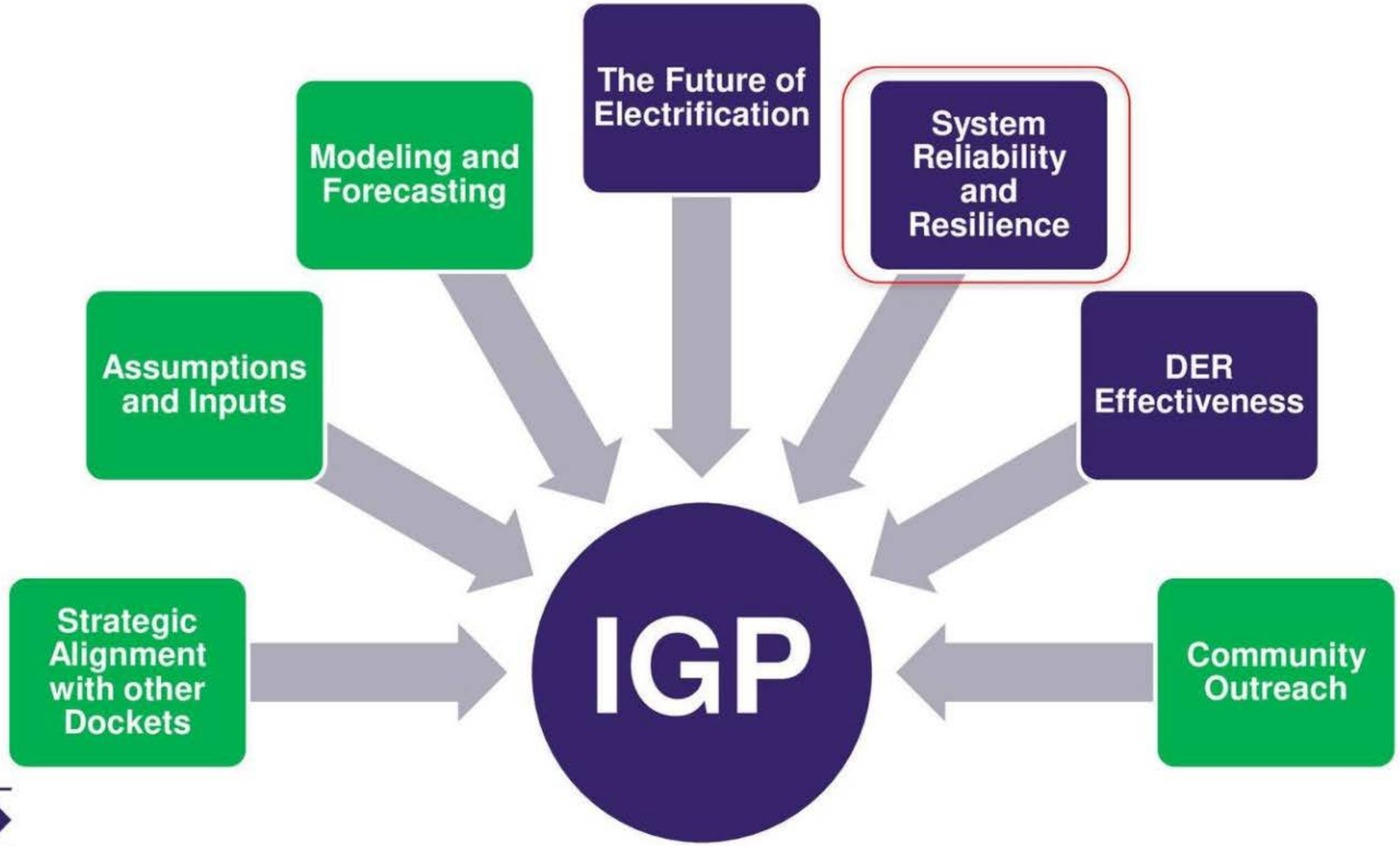
Pulse Check Feedback



Introduction & Context

IGP Stakeholder Council – Strategic Topics



Resilience is concerned with high-impact, low-frequency events

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Reliability

Today's Discussion

System Stability	System Balancing	Transmission and Distribution	Resource Adequacy	Resilience
• High penetrations of inverter-based resources • Essential reliability services • Frequency, voltage, stability	• Wind and solar variability and uncertainty • Managing and balancing of resources	• Equipment failures, vegetation, auto accidents • Grid modernization – automation and field devices to reduce duration of outages • Outages commonly measured in frequency and duration	• Seasonal demand/load uncertainty • Generator/BESS failures or outages • Multiple days in a row of low solar wind output • 1 day in 4.5 years annual loss of load probability	• Hurricanes, storms, flooding, lava flow, and other extreme weather events • Cybersecurity • Hardened infrastructure • Microgrid solutions

Sub-seconds → Years

Defining Resilience

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resilience noun

re·sil·ience l \ ri-’zil-yən(t)s

Definition of *resilience*

1. : the capability of a strained body to recover its size and shape after deformation caused by compressive stress
2. : an ability to recover from or adjust easily to misfortune or change

“Resilience is the ability of a system or its components to adapt to changing conditions and withstand and rapidly recover from disruptions.”

Hawaii Public Utilities Commission Staff, PBR Docket

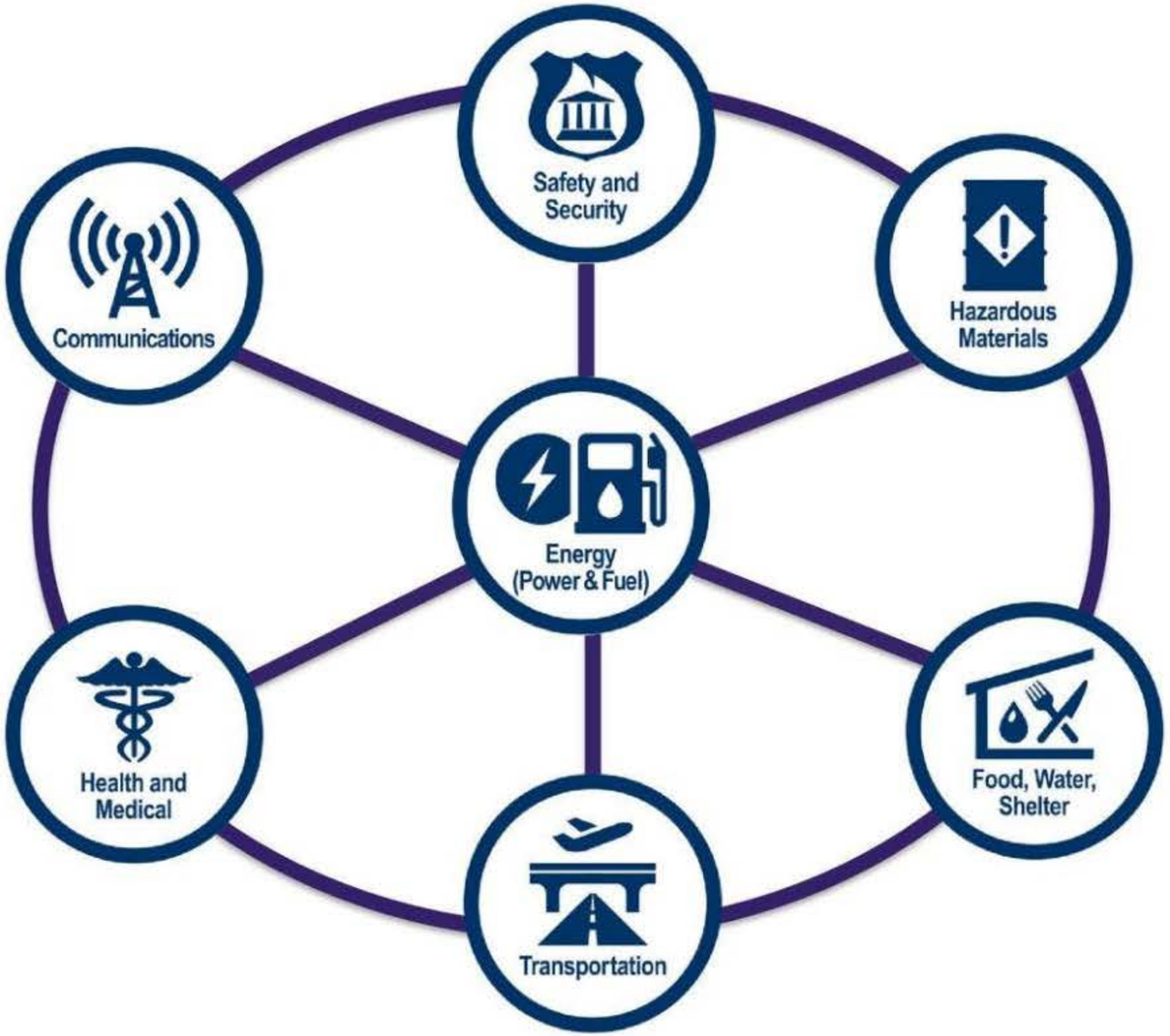
For critical infrastructure, generally involves the ability to anticipate, absorb, adapt to, and rapidly recover from a potentially catastrophic event while sustaining mission critical functions.

We don’t want this to be Hawaii

Hurricane Maria (Cat V) damage in Puerto Rico (September 2017)

Hurricane Ida (Cat IV) damage in Louisiana (August 2021)

Energy is a lifeline to other community lifelines



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Infrastructure is one of many elements of grid resilience

Infrastructure

Cybersecurity

Emergency Response Training

Mutual Aid Agreements

Inventory Management

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Role of Preventive and Mitigation Solutions

Preventive and mitigation solutions are complementary and necessary means to improve resilience

Solutions to Prevent Outages or Damage

Outages or Damage

Solutions to Mitigate Impacts if Preventive Solutions Fail

- Transmission hardening
- Hardening critical circuits
- Hardening critical poles
- Wildfire prevention
- Substation flood mitigation
- Pole/line relocation to avoid threats
- Vegetation management
- Undergrounding

Preventive Solutions

- Microgrids
- Critical Customer Hubs
- Minigrids
- DER
- Backup generators
- Backup distribution ties
- New transmission lines
- Emergency response and restoration

Mitigation Solutions

What are some recent events that add to/change the urgency of resilience investment?

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California wildfires, Texas power freeze, Fukushima meltdown

Storms that impact other states give indication that we here on the islands need to always look at how we can improve our systems to be more resilient

COVID-19 Pandemic

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Extreme weather in Pacific Northwest and Texas

Oil Price Volatility

Rapid increase in frequency of climate related natural disasters

Covid Oxygen shortageLack of morgue space

Supply Chain Disruptions

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What are some recent events that add to/change the urgency of resilience investment?

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King tides

Climate change

Pledges of COP 26 suggest no gov is doing enough to limit temperature rise

Increased events due to climate change

Prolonged electric grid outages (e.g., outage in Texas due to extreme cold, outage caused by Hurricane Ida, etc.)

Push to transition Hawaii's economy to diversify beyond tourism (promote local circular economy)

Hawaii overly dependent on imports and most infrastructure vulnerable to storms

supply chain issues

Heat waves

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What are some recent events that add to/change the urgency of resilience investment?

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The rising threats in the Indo Pacific.

infrastructure bill passing

Sustainable self-sustainment

success of interagency coordination - e.g. Army/Hawaii County addressing wildfires

Changes in consumer expectations and behaviors

Changes in consumer expectations and behaviors

Any underground coastal power infrastructure subject to coastal erosion and inundation from sea level rise?

Hurricane Lane was a near miss of a major hurricane that could have impacted power, ports, transportation, and homes

Let's see, BWS has ~7 portable generators with a prioritized deployment plan for the island, depending on the severity of the power outage. And just completed 4 permanent generators at primary pump stations serving town and Ewa. More are needed.

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What are the implications for addressing this expected need, given the time to implement solutions (including regulatory approvals)?

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Risk management. Decades. Public-private partnerships. Government requirements/ordinances

Need to consider importance of infrastructure with multiple benefits. For example, new REZ transmission may be more resilient than existing transmission

If need isn't addressed on time for a major storm (one like Puerto Rico's Maria will come anytime), state will suffer badly

Need to identify clear goals and inter-agency coordination in light of specific needs for Hawaii as isolated island grids; including coordinating on timelines, permitting, and sharing of fiscal resources.

Recognize that a major outage is inevitable. Prepare the public to be ready with proactive communications, media and active support for community planning for resilience & response so they can be more self-reliant when cut off.

Educate educate educate people to prep prep prep with lots of water storage, extra food, and backup power

The ability to utilize utility capital for cost match on federal grants given the regulatory approval process and timeline. Federal dollars can substantially reduce the cost of resiliency however the approval and implementation and approval time line

ID & include preventive & mitigation solutions for resiience in all new RFPs and utility-led projects

Making sure people have clean water is the most important thing. Water delivery requires energy.

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What are the implications for addressing this expected need, given the time to implement solutions (including regulatory approvals)?

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How much back up power does board of water supply and private water utilities have?!?

Puerto Rico was closer to mainland than Hawaii to get help...

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Presentation by Keith Yamanaka

U.S. Army Garrison Hawaii Directorate of Public Works

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USAG-HI Installation Energy and Water Plan

Keith Yamanaka
Energy Manager
Directorate of Public Works

Version 1.0
As of 23 September 2021

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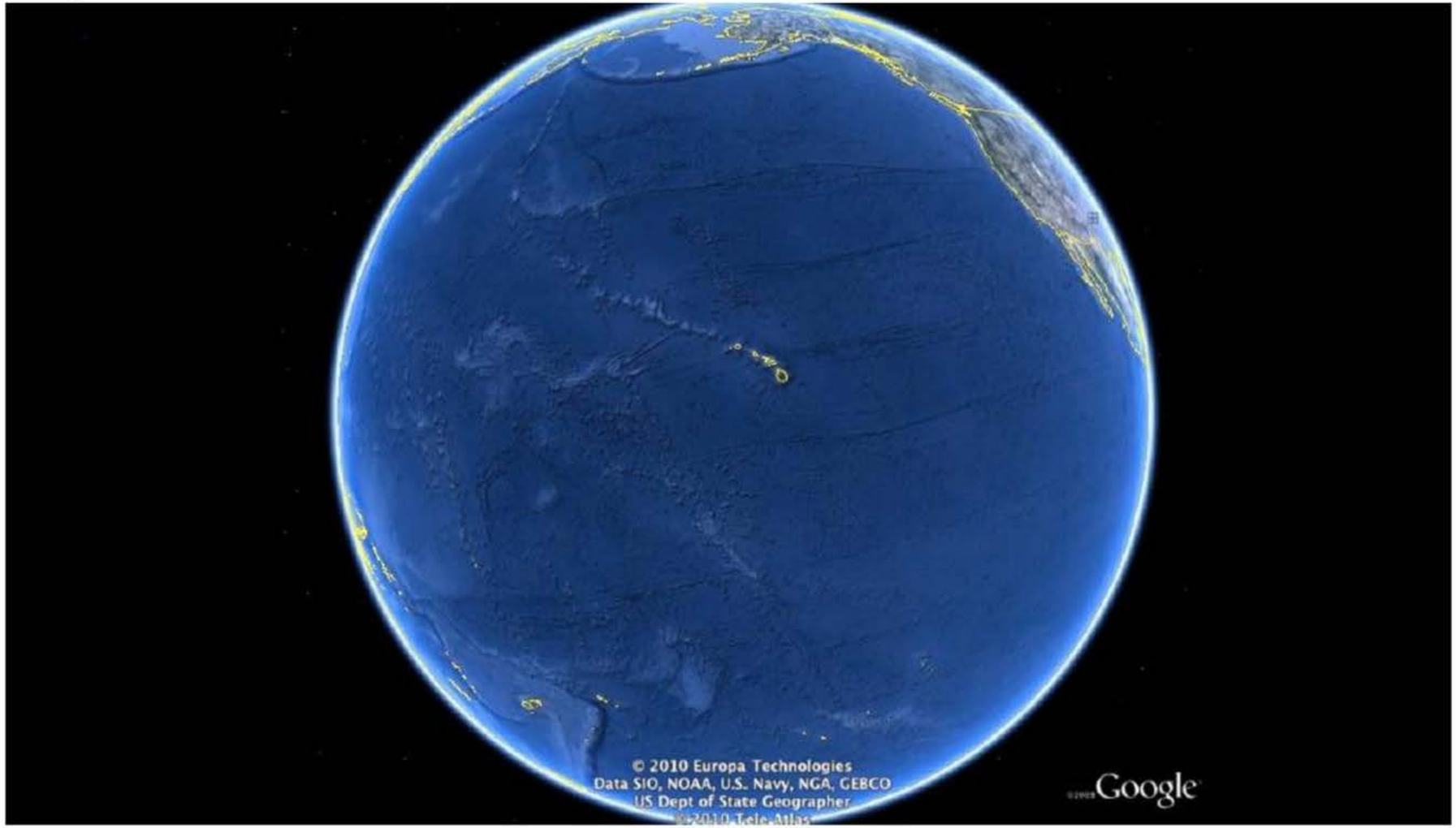

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Goals

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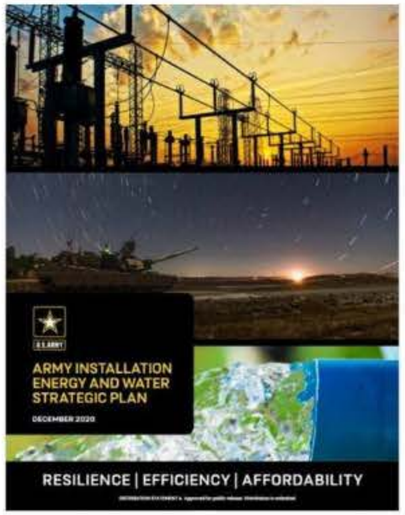
Army



"The Army has set an ambitious goal that a brigade combat team will need to sustain for seven days without resupply. Right now, resupply is required at five days"
Army E&S NEWS | Summer 2019

***Secure Critical Missions**: "The Army will reduce risk to critical missions by being capable of providing necessary energy and water for a minimum of xx days."*
***Sustain All Missions**: "The Army will improve resilience at installations, including planning for restoration of degraded energy and water systems and reducing risks of future disruptions, by addressing the following attributes: assured access to resource supply, reliable infrastructure condition and effective system operations."*
Army Directive 2017-07 (Installation Energy and Water Security Policy) | 23 Feb 2017

USAG – Hawaii

The goal of the IEWP is to generate robust, cost effective projects that will mitigate long term energy and water outages lasting up to 5 days by applying simple and straightforward methods:

- Reducing distance and points of failure between source and load
- Providing alternate paths from source to load
- Utilizing existing infrastructure to reduce costs
- Utilizing conventional emergency generators for immediate restoration for short outages (3-5 days)
- Implementing utility scale measures for long outages Identify and harden platforms that can readily support mobile operations
- Reducing energy use to extend onsite resources

Keith Yamanaka/808-656-1036/keith.k.yamanaka.civ@mail.mil

Resilience

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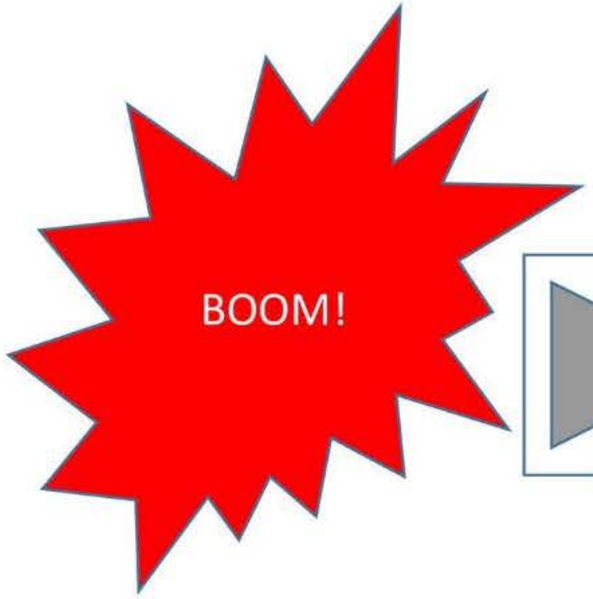
Resilience

Reliability

Resources
Redundancy
Robustness
KISS



Restoration

Recovery
Response
KISS

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Risk & Approach

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Risk

- Natural Hazards as identified in the 2018 State of Hawaii Hazard Mitigation Plan
- Malicious activity – cyber-attack, shipping disruption
- Condition of infrastructure

Ranking	2018 Hazard Ranking Order	Mission Risk
1	Climate Change/Sea Level Rise	Loss of Generation
2	Hurricane	Loss of Generation & Lines
3	Tsunami	Loss of Generation
4	Earthquake	Loss of Generation & Lines
5	Volcanic (lava or vog)	Loss of Solar
6	Wildfire/Landslide	Loss of Lines

Natural Hazards – 2018 State of Hawaii Hazard Mitigation Plan

USAG – Hawaii's Approach

- PRIMARY – Existing Grid Power
- SECONDARY - Utilize conventional emergency generators for immediate restoration for critical facilities
- ALTERNATE – Implement utility or portable measures for prolonged outages lasting beyond 2-3 days (wire or non-wire solutions)
- Reduce distance and points of failure between source and load (onsite generation, reduce circuit length)
- Provide alternate paths from source to load (loop circuits, cross connects)
- Utilize existing infrastructure to reduce costs
- Identify and harden facilities that can serve as fall back facilities
- Reduce energy use and implement renewables to extend onsite fuel duration
- Integrate and align with Hawaii's energy plan

Keith Yamanaka/808-656-1036/keith.k.yamanaka.civ@mail.mil

HECO Schofield Generating Station (SGS) Blackstart Test

HECO SGS Blackstart Test

- In May 2021, HECO and the Army performed a simultaneous outage of Schofield Barracks, Wheeler Army Airfield and Field Station Kunia to test blackstart capability of SGS
- Verified the capability to separate the 3 installations from the grid and restore power with SGS within 2 hours
- Required the ability of the Army electrical system and DPW personnel to **manually** perform over 90 switching operations across multiple locations to ready the system to accept power from SGS
  - Digital protective relays and modified settings required for breakers to properly operate with two different fault current characteristics
  - 2 HV electricians and one Supervising Engineer coordinated switching and sequencing with HECO plant operators to insure loading parameters and clean air requirements were met
  - Pre-existing line failure on 2 feeders loaded onto one feeder resulted in high block load that required mitigation against under-frequency (loading) and over-frequency (unloading)
- Emergency generator effects had to be considered as large block loads
- Large HVAC, Water and wastewater plant loads were overridden for manual start
- Required all rooftop PV systems to be isolated (11 MW)
- Verified SGS can meet all load requirements within a 24 hour window while operating on biodiesel.
- Verified SGS can accommodate 2 MW of full sun PV with no degradation of power quality
- Provided data to establish higher PV tolerance levels for future events
- Provided training and information to Army and HECO that will improve optimize response, recoverability and system capabilities for future events
- Satisfies the requirements of the SGS lease
- Army was 100% renewable energy for 33 hours.

Schofield Generating Station (SGS) Microgrid

SGS Features

- Robust and redundant – Six 8.3 MW multi-fuel marine diesels (4 plus 2)
- Resource diverse – utilizes 3 MGALS of biofuel annually and can operate on conventional diesel, 5-7 days of fuel stored onsite
- Secure – located within a military installation, only plant not on coastline
- Recovery - Within 2 hours can black start Schofield Barracks, Wheeler Army Airfield and Field Station Kunia
- Responsive – Meets Army loads and provides non-spinning reserve and black start services to the grid
- Army receives first right for power in lieu of cash rent
- Enhances Army's ability to provide disaster support to Hawaii

Keith Yamanaka/808-656-1036/keith.k.yamanaka.civ@mail.mil

Identification of No-Regrets Activities to Start Sooner than Later

Hawaiian Electric is proposing an initial set of targeted, no-regrets, resilience enhancements to harden our system in parallel with IGP

Maui Program - $48M

- Transmission Hardening
- Critical Pole Hardening
- Critical Circuit Hardening
- Pole Storm Surge and Sea Level Rise Mitigation
- Substation Flood Monitors
- Wildfire Mitigation
- Hazard Tree Removal (O&M)
- Resilience Modeling (O&M)
- Maui Distribution Feeder Ties

Hawaii Island Program – $76M

- Transmission Hardening
- Critical Pole Hardening
- Critical Circuit Hardening
- Pole Storm Surge and Sea Level Rise Mitigation
- Substation Flood Monitors
- Wildfire Mitigation
- Hazard Tree Removal (O&M)
- Resilience Modeling (O&M)

Oahu Program - $220M

- Transmission Hardening
- Critical Pole Hardening
- Critical Circuit Hardening
- Pole Storm Surge and Sea Level Rise Mitigation
- Substation Flood Monitors
- Wildfire Mitigation
- Hazard Tree Removal (O&M)
- Resilience Modeling (O&M)
- Lateral Undergrounding

Specific to Operating Area

What characteristics of a critical customer circuit would make it no-regrets to harden now?

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Water, wastewater, hospital, and first responders must come first

Wastewater!

Can we add grocery stores, drug stores & hardware stores, & gas stations to Tier 2? All these are critical to communities helping themselves

Water

water, wastewater, hospitals

Disaster Shelters....not sure if we have any though

Circuits that support Public safety, critical infrastructure as defined by CISA

Major highways and streets

For Telecom, work with HawTel and Spectrum to understand their critical high capacity and NNI fiber circuits (similar to transmission lines on electric grid)

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What characteristics of a critical customer circuit would make it no-regrets to harden now?

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Agree with Tier 1 in slide deck. Tier 2 should include critical businesses for community health & recovery (groceries, pharmacies, hardware stores, gas stations). Were those considered?

The tiered priority customer classifications is a good start and, as suggested, determining priority density, would help to inform decisions. Assume that can't build to prevent all occurrences. So, some analysis that shows trade-offs would help

Resilience hubs that serve the community in times of shocks and stressors (i.e. year round resilience services)

Grocery stores and pharmacies

Resilience hubs that serve the community in times of shocks and stressors

Resilience hubs that serve the community in times of shocks and stressors

Transportation centers, Airports, Harbors, economic centers, in addition to critical infrastructure to public health and safety.

Sorry, need to jump off. We didn't really talk about how the pandemic affected us & whether that changes anything. Would like to have that discussion. One thing to note is oxygen supply, neither of the two air separation plants have emergency power.

Radial circuits

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What characteristics of a critical customer circuit would make it no-regrets to harden now?

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What happens to large scale solar installs when they're hit directly by a hurricane? Are these assets hardened enough to still be functional when hit by high winds?

How does heat affect the grid, if it was say 10 degrees hotter, would circuits and controls be impacted or design life shortened?

Who pays for these "give out" suggestions?

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How can we ensure all customers have equitable access to resilient electricity?

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What happens to large scale solar installations when they are hit by a large hurricane? Are these assets hardened enough?

Give out battery packs to lower income communities with education materials on charging them up well in advance of storms!

Raise awareness of the resilience needs and costs to provide resilient electricity and work with stakeholders (e.g., communities, legislature, etc.) to help find funding solutions to meet resilience needs for the vulnerable communities.

Work with communities to identify critical customer hubs that can serve communities when needed.

Provide community-based micro-grids that serve localized, neighborhood-scale needs.

In addition to low income, elderly communities, what about residences in the back of valleys, high rainfall areas where solar radiation days are limited disincentivizing PV with battery backup...

work with communities by island to identify island priorities and needs

Give out storm preparedness kits with solar lights and battery packs and collapsible water jugs and other edu materials

Who pays for these "give out" suggestions?

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How can we ensure all customers have equitable access to resilient electricity?

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Work with board of water supply more to educate community together

Prioritize local workforce so that we have the skills on island to respond when a disaster hits and are not dependent on outside expertise/staffing.

Create known Resiliency hubs, similar to shelters. HECO can't address all issues. In actual emergency/disaster, HECO support will be limited. Local towns must also develop a plan.

Come up with program to pay for give out solutions

Prioritize local workforce so that we have the skills on island to respond when a disaster hits and are not dependent on outside expertise/staffing.

Integrate County and State climate action and resiliency plans into IGP

Penalties for non-performance in PPA's (perhaps even in SIA's) for all resources. nd social order needs.

Regulatory language/PUC (minimal) requirement. Utility-level criteria. Selectively pre-prioritize resilient "corridors". State, City, PUC, Tier1 concurrence.

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Efforts to Improve Forward-Looking Resilience Planning and Options Analysis

Additional tools and capabilities are needed to better quantify resilience investments and compare options

- Resilience metric development and benefit-cost analysis is an eminent challenge in the power industry
- There are no formal metrics or methods to evaluate resilience in the power industry that have received universal acceptance and adoption
- Quantifying resilience is difficult due to the low frequency and unpredictable nature of resilience events, complexity of threat modeling and damage prediction, as well as the difficulty of quantifying downstream impacts of outages (e.g., economic losses, social burden impacts)
- As a result, calculating cost-benefit characteristics and performing options analysis of resilience enhancements is exceedingly difficult to do with precision

We are pursuing performance-based resilience modeling capabilities

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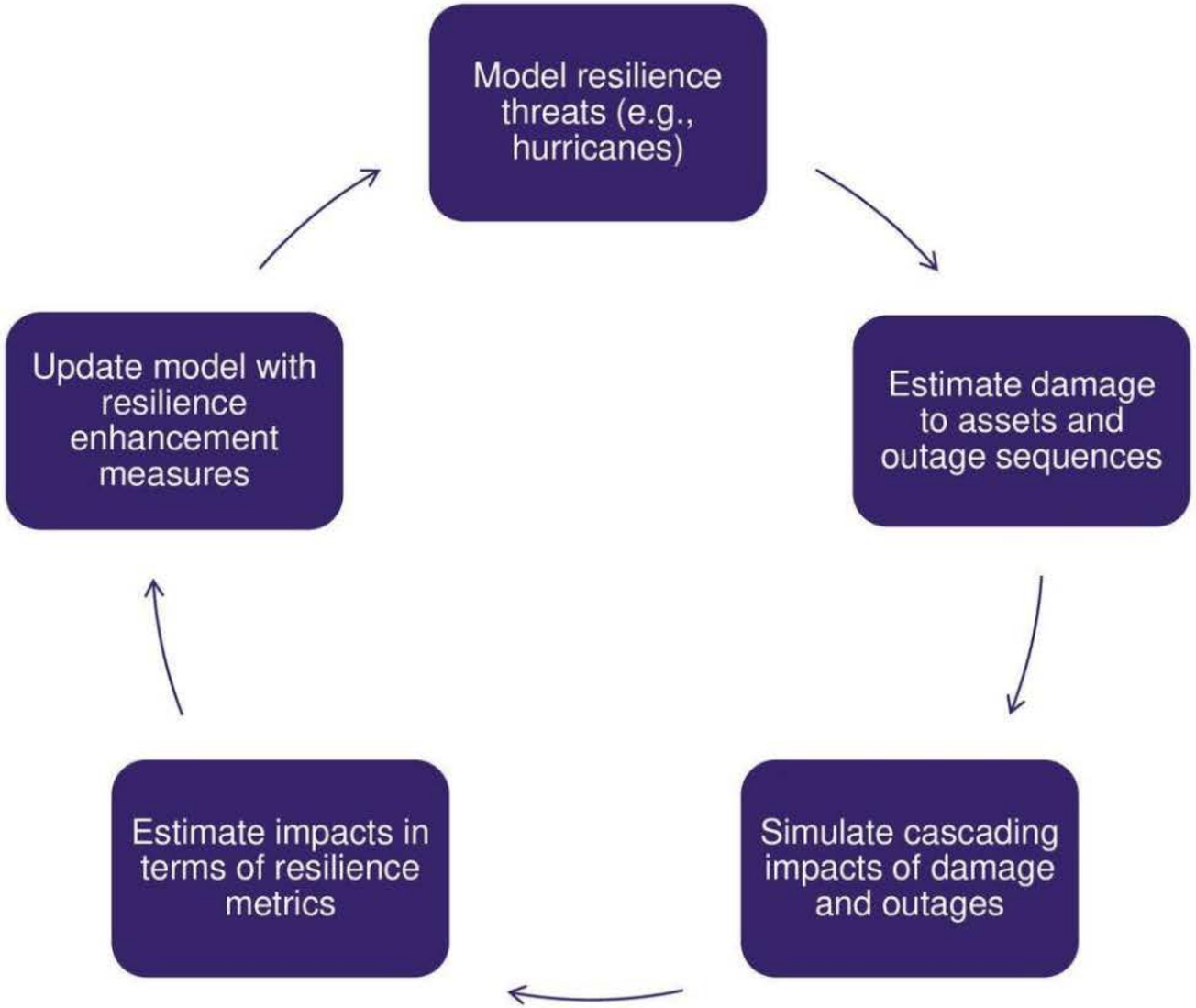
- We are working with national labs and universities to scope performance-based model development to:
  - Evaluate system resilience
  - Quantify benefits of resilience enhancements
  - Perform options analysis of investment options in terms of their expected benefits to system damage and recovery under severe event scenarios

This will allow us to evaluate current resilience and test resilience enhancements



Next Steps

- Best way to continue the reliability and resilience discussions?

IGP Status Update

- Filed the Grid Needs Assessment Methodology, process, and planning criteria on 11/5/2021.
- Starting to update models to begin modeling the different IGP scenarios

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Mahalo for your time and input!